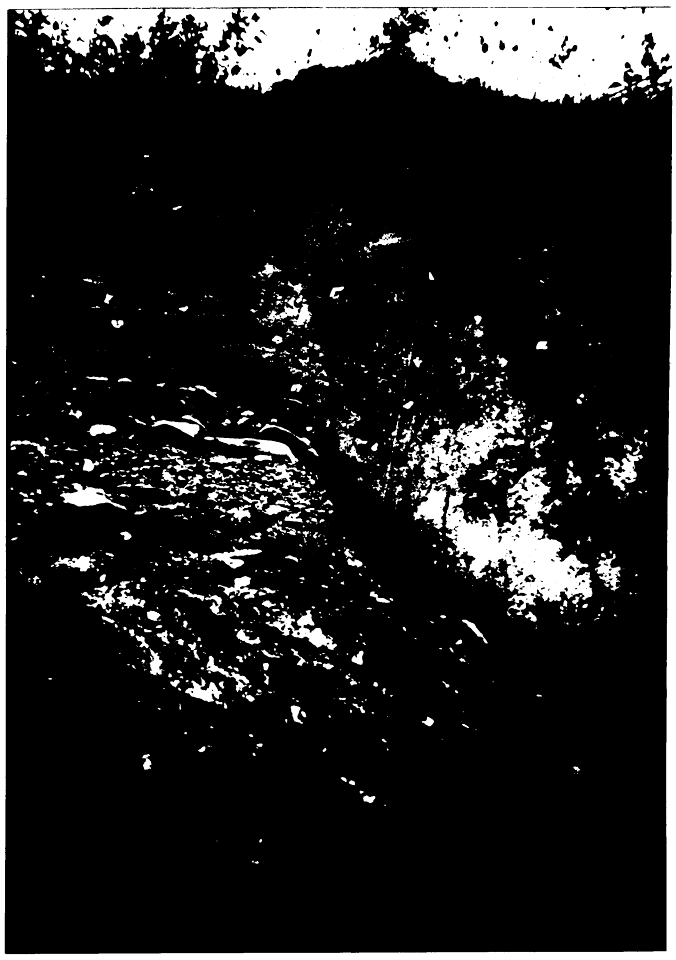

Figure 9. North view of fault zone exposed in the Roundy Farm stream cut, Junction Hills fault.

eroded when Lake Bonneville transgressed over the site. Unit 2 may also be paleochannel deposits along the base of the scarp, which would account for its thinness in the footwall.

Units 1 and 2 are overlain by a transgressive sequence of Lake Bonneville deposits. The basal portion of these deposits is a well-bedded gravel with sand (unit 3, plate 1B). Unit 3 is overlain by silty sand with gravel (unit 4) and silt having interbedded sand layers (unit 5, plate 1B). A weakly developed soil A horizon formed on top of unit 5 (paleosol S1, plate 1B). All these units were downdropped to the east by the MRE. The MRE also formed a graben (bounded by a west-dipping antithetic fault) showing considerable deformation (small faults and cracks), and a shear zone along the main fault comprised of units 2 through 5 and paleosol S1 (unit 6a, plate 1B). A colluvial wedge roughly 1.3 meters (4.3 ft) thick lies on top of paleosol S1 (unit 6b, plate 1B). Unit 6c (plate 1B) is a crack that likely filled with material derived from paleosol S1.

The upper portion of units 5, S1, 6b, and 6c have been removed, and they are overlain by a plowed horizon in which a modern soil is forming (unit 7S, plate 1B).

Earthquake Timing and Recurrence

We collected one sample of organic material from the Roundy Farm stream-cut exposure for radiocarbon dating. Radiocarbon analysis of this sample, which consisted of slightly organic sediment collected from unit 6b and the top of paleosol S1 (RF-RC1, plate 1B), gave an age estimate of 8,450 +/- 200 cal B.P. This suggests the MRE on the Junction Hills fault occurred around 8,250 to 8,650 years ago. No material was found to determine timing for the PE on the Junction Hills fault, but lake sediments exposed at Roundy Farm postdate the PE. The basal portion of these sediments was likely deposited about 22,500 years ago (19,500 yr B.P.) as Lake Bonneville transgressed over the site (Oviatt and others, 1992; Donald R. Currey, written communication, 1995). Thus, a minimum of 13,850 years passed between the PE and MRE.

Displacement and Slip Rate

Due to agriculture, the scarp at Roundy Farm has been altered. Therefore, we measured no topographic profiles at this site. The remaining surficial expression of the Junction Hills fault is subdued, rendering profiles inconclusive. However, correlative transgressive lake deposits are in both the footwall and hanging wall in the stream-cut exposure, and therefore we could directly measure the amount they were displaced. Units 3 and 4 show evidence of drape on a pre-existing scarp or possible drag. Unit 5 is mostly horizontal on both sides of the fault zone. Therefore, we measured displacement in the basal contact of unit 5, between the fault zone and meter mark 7.5. This contact shows 2.9 meters (9.5 ft) of net displacement from the MRE. No correlative stratigraphy was evident in the stream-cut exposure to indicate displacement from the PE.

Assuming the lake beds in the stream cut are displaced 2.9 meters (9.5 ft) and were deposited since 22,500 years ago, the maximum slip rate for the Junction Hills fault during post-Bonneville time is 0.13 millimeters/year (0.005 in/yr). This rate is lower than the average slip rate for the central segment of the East Cache fault zone of 0.28 millimeters/year (0.01 in/yr) (table 2; McCalpin, 1994). Evans (1991) estimates net slip of 600 to 1,200 meters (2,000-3,900 ft) on the West Cache fault zone in the vicinity of the Junction Hills fault since Miocene extension of Cache Valley began, resulting in an average slip rate of 0.04 to 0.06 millimeters/year (0.0016-0.0024 in/yr). This rate is also lower than for the central segment of the East Cache fault zone since Miocene time of 0.29 to 0.54 millimeters/year (0.011-0.021 in/yr) (Evans, 1991).

Wellsville Fault

Geology

The Wellsville fault is 20 kilometers (12 mi) long and consists of an east-dipping normal fault that branches northward into two subparallel fault traces (figure 1). The eastern fault extends about 16 kilometers (10 mi) and separates Tertiary sedimentary rock in the hanging wall from Paleozoic sedimentary rocks in the footwall. The eastern fault is covered by Quaternary deposits between bedrock outcrops; at its northern end the fault is concealed by Pleistocene alluvial fans, whereas at its southern end the fault is concealed by Lake Bonneville and younger deposits. The western fault extends about 13 kilometers (8 mi) and for much of its length marks a sharp boundary between Paleozoic bedrock and Tertiary and Quaternary deposits.

Solomon (1997) indicates evidence of Quaternary displacement exists in two areas along the Wellsville fault. The first area is on the western fault branch at the mouth of Deep Canyon, where Oviatt (1986) notes 15 meters (49 ft) of displacement in middle to upper Pleistocene alluvial-fan deposits. However, Solomon (1997) indicates upper Holocene fan alluvium in the canyon is apparently not displaced. The second area is at the mouth of Pine Canyon, 7 kilometers (4 mi) to the south of Deep Canyon. At the mouth of Pine Canyon, Solomon (1997) found several small faults and tilted beds exposed in the wall of a gravel pit excavated on the edge of prograding spits near the Bonneville shoreline. Cumulative displacement across these faults is at least 2 meters (7 ft) (Solomon, 1997). However, Solomon (1997) believes deformation in the gravel pit is probably the result of landsliding, rather than displacement on the Wellsville fault.

Surficial deposits in the vicinity of Deep Canyon include upper Holocene to middle Pleistocene fan alluvium, landslide deposits, and undivided alluvium and colluvium; and upper Pleistocene Bonneville transgressive gravel, sand, and silt (figure 10; Solomon, 1997). Unit afo mostly comprises an old alluvial fan above the Bonneville shoreline at the mouth of Deep Canyon, similar to the dissected alluvial fans estimated by McCalpin (1989) to be 100,000 to 200,000 years old. Downcutting along the drainage issuing from Deep Canyon has dissected the alluvial fan at the canyon mouth by more than 30 meters (100 ft).

Sequence of Deposition and Faulting in the Deep Canyon Trench

The Deep Canyon trench was excavated north of the mouth of Deep Canyon across a 7-meter- (23-ft-) high multiple-event scarp of the Wellsville fault. The trench exposed two main faults (figure 11), smaller subsidiary faults, and evidence for two surface-faulting earthquakes. The oldest units exposed in the trench are a series of interbedded coarse- to fine-grained alluvial-fan deposits comprised of clay, silt, sand, and gravel (units 1-3, plate 1C). These units were displaced down to the east (below the trench floor) by the PE on the Wellsville fault. The PE formed a wide fissure that filled with material likely derived from units 1 and 2 (unit 4a), and a colluvial wedge (unit 4b) formed on top of units 2, 3, and 4a after the event (plate 1C). Units 3 and 4b are overlain by additional alluvium (unit 5, plate 1C).

No younger alluvial-fan units are evident in the trench exposure. We believe after the retreat of Lake Bonneville, the alluvial fan at the Deep Canyon trench site became inactive as it was downcut and deposition moved farther eastward in the valley. Units 4b and 5 are overlain by

DESCRIPTION OF MAP UNITS AND SYMBOLS

al1	Stream alluvium (upper Holocene)	afo	Pre-Lake Bonneville fan alluvium (upper to middle Pleistocene)
af1	Fan alluvium, unit 1 (upper Holocene)	R	Bedrock, undivided
af2	Fan alluvium, unit 2 (middle Holocene to uppermost Pleistocene)		
cls	Landslide deposits (Holocene to upper Pleistocene)		Normal fault, bar and ball on downthrown side, dashed where approximately located.
ca	Colluvium and alluvium, undivided (Holocene to middle Pleistocene)		Contact
lbg	Bonneville transgressional gravel and sand (upper Pleistocene)	—B—	Highest shoreline of the Bonneville level
lbs	Bonneville transgressional sand and silt (upper Pleistocene)	Δ	Trench site

Figure 10. Air-photo geologic map of the Deep Canyon trench site vicinity (modified from Solomon, 1997).